

SECRETNPIC/TDS/D-1177-67
12 December 1967

MEMORANDUM FOR THE RECORD

25X1A SUBJECT: [] Viewer

25X1A 1. In November 1967, a number of the members of the Exploitation Systems Branch/Development Staff had an opportunity to attend a demonstration of the [] Virtual Image Stereo Viewer.

2. The following is a list of observations and comments on that demonstration:

a. The stereo viewer is a modification and further development of the Virtual Image Viewer designed and fabricated for NPIC under a FY-1964 contract.

b. The diffraction gratings used were those developed under our contract and as expected they still exhibited the peculiar banding problem first surfaced in our FY-1964 effort; however, it should be pointed out that while the banding effect was quite evident, it appeared to be a considerable reduction over that exhibited by our viewer. Part of this reduction is probably due to the decrease in magnification. (The original viewer could operate at 50X).

c. An important change in this viewer is that it works with white light rather than the highly monochromatic (Hg) light source used in the first virtual image viewer. This improvement, once again, may result from the reduced magnification parameter, since the virtual image viewer worked well at 5X with multi-spectral light but poorly at 50X.

25X1A d. Resolution and image quality of the stereo presentation were excellent as anticipated. There was, however, considerable evidence of field curvature. This was to be expected since it is inherent in the large field lens designed by [] It is for this reason that the viewer aperture is TV Tube shaped rather than square since this format does not provide the eye with a proper point of reference, thereby, making the curvature less annoying.

DECLASS REVIEW by NIMA/DOD

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e. The stereo presentation is excellent, sharp, clean and with good 3-D effect. There does appear to be some problem in stereo registration when the display is viewed from a slight angle; however, this is no worse than many other competitive systems.

f. In the process of modifying the viewer for stereo, part of the range through which the head can move (in and out) has been lost. This restricted head movement makes this system less an advantage over direct viewing systems utilizing eyepieces than might otherwise be the case.

3. These are our major observations. Based upon these observations and our background and experience, I would make the following recommendations:

a. That the key to this system is the diffraction grating and if we cannot improve (or replace) the grating in the system, that further development of the system is a waste of time since everything else involved is well within the current state-of-the-art.

b. That we find further grating development--when, and if, we find a new technique or approach that appears highly promising. I am unaware of any at this time.

Chief, Exploitation Systems Branch,
TDS

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[] proposes a three phase program whose goal is to achieve a pair of special ten inch by ten inch aperture diffraction gratings. These gratings will be substantially identical. They will each have a nominal 1000 grooves per inch and will each be so designed that the energy incident on the grating will be divided into nine equally intense orders (the zero order, and the first four orders on both sides of the zero order). "Equal intensity" will be taken to mean that the variation in intensity between adjacent orders will not be more than 40 percent, and the overall intensity ratio among all orders will not be over two to one. The exact values are to be determined subsequent to contract initiation.

In Phase I the method most probable of success within the total contract time will be determined. The principal (indeed the only) problem in producing such a grating as that described is the problem of achieving the desired energy distribution. A number of methods for realizing the desired grating have been proposed. We list these below with some comments.

1. Groove Shaping

That shape of the groove is determined which will produce a grating of the required energy distribution. If such a groove is a portion of a circular cylinder the shape is realizable. If a different shape is called for then the task will be more difficult and thus more time consuming. Some theoretical investigations of cylindrically shaped grooves have been carried out, notably by Fano, but only limited experimental background exists.

2. Ghost Grating

A grating with such periodic error is produced that the two first orders, two ghosts on either side of each first order, and the zero order all have equal intensity (eleven images in all). The advantage of this kind of construction is that the groove structure is finer (approximately 3000/inch) and hence less visible. The groove would be required to also have the correct shape as well as having an appropriate periodic error.

3. Double Grating

It may prove to be more simple to make two gratings each of which has two first orders and a zero order of equal intensity. Two such gratings with parallel grooves would produce five approximately equal orders. Four gratings in all would be required and alignment between the two parallel gratings would have to be quite exact.

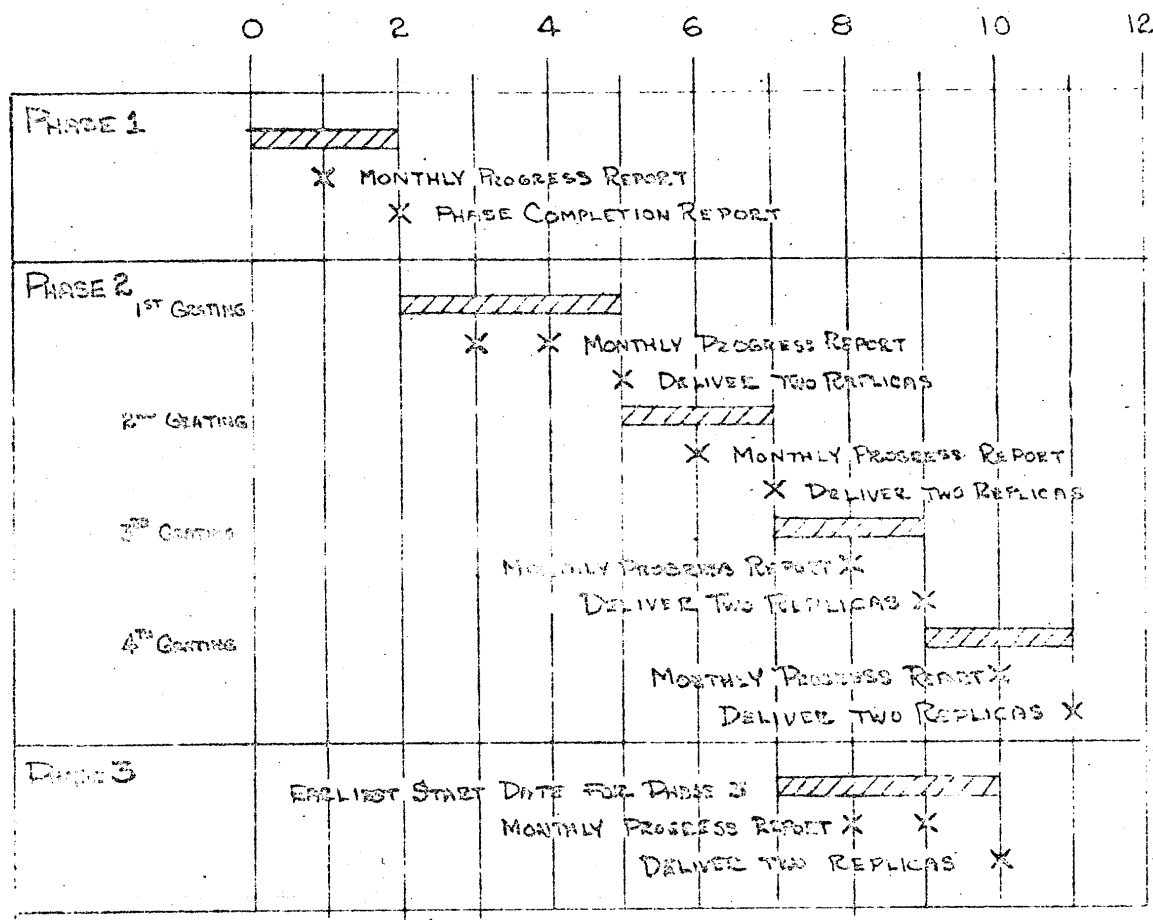
During the studies of Phase I other methods may occur. These other methods will also be evaluated on the same basis, i.e., the probability of achieving the desired end result in the allotted time. At the conclusion of this phase a report will be issued having our recommendation how best to proceed.

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In Phase II the method judged most probable of success in Phase I will be used to rule a two inch by two inch sample diffraction grating. A transmission replica of this sample grating will be made and the relative intensity of the various images will be measured. The measurement will be made using the 5461 mercury line with collimated light incident normal to the unrulled side of the grating. A telescope and detector will be angularly scanned through the orders of the grating and the relative intensity of the orders measured. Two replicas and the measurement record will be delivered. If additional replicas are desired they will be charged for additionally.

It is unlikely that the first of these rulings will produce replicas having a satisfactory energy distribution. Therefore as an additional part of Phase II and on mutual agreement a second two by two inch ruling will be made embodying the knowledge gained from the first. Transmission replicas from this second grating will be measured and the replicas and measurements delivered. Subsequent two by two inch gratings will be ruled and replicas submitted as mutually agreed on. It is probable that a total of four attempts will be required to achieve the desired level of performance.

Phase III will use the results of Phase I and II to produce and deliver two 10 by 10 inch transmission replicas to specifications nominally as already stated, and in detail as mutually agreed on.



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